FORM PTO-1390 (Modified) (REV 11-98) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER	
112740-281	
U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR	
Unknown 09/914002	

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/DE00/00309	1 February 2000	19 February 1999

TITLE OF INVENTION

METHOD AND DEVICE FOR SYNCHRONIZING A RECEIVER WITH A TRANSMITTER

APPLICANT(S) FOR DO/EO/US

Bernhard Raaf et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ A copy of the International Search Report (PCT/ISA/210).
8. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☐ have not been made and will not be made.
9. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
10. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

Items 13 to 20 below concern document(s) or information included:

13. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☒ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☒ Certificate of Mailing by Express Mail
20. ☒ Other items or information:

Submission of Drawing Figure 1 on one sheet

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
09/914002 Unknown	PCT/DE00/00309	112740-281

21. The following fees are submitted:.

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

		CALCULATIONS PTO USE ONLY
☐	Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2) paid to USPTO and International Search Report not prepared by the EPO or JPO **$1,000.00**	
☒	International preliminary examination fee (37 CFR 1.482) not paid to USPTO but Internation Search Report prepared by the EPO or JPO **$860.00**	
☐	International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **$710.00**	
☐	International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$690.00**	
☐	International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) **$100.00**	
	ENTER APPROPRIATE BASIC FEE AMOUNT =	**$860.00**
	Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).	**$0.00**

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	17 - 20 =	0	x $18.00	**$0.00**
Independent claims	2 - 3 =	0	x $80.00	**$0.00**
Multiple Dependent Claims **(check if applicable)**.			☐	**$0.00**
	TOTAL OF ABOVE CALCULATIONS		=	**$860.00**
	Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28) **(check if applicable)**. ☐			**$0.00**
	SUBTOTAL		=	**$860.00**
	Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)).		+	**$0.00**
	TOTAL NATIONAL FEE		=	**$860.00**
	Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).** ☐			**$0.00**
	TOTAL FEES ENCLOSED		=	**$860.00**
				Amount to be: refunded $
				charged $

☒ A check in the amount of $860.00 to cover the above fees is enclosed.

☐ Please charge my Deposit Account No. in the amount of to cover the above fees.
A duplicate copy of this sheet is enclosed.

☒ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. **02-1818** A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Thomas C. Basso (Reg. No. 46,541)
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P.O. Box 1135
Chicago, Illinois 60690

Thomas C. Basso
SIGNATURE

Thomas C. Basso
NAME

46,541
REGISTRATION NUMBER

August 20, 2001
DATE

BOX PCT

IN THE UNITED STATES ELECTED/DESIGNATED OFFICE

OF THE UNITED STATES PATENT AND TRADEMARK OFFICE

UNDER THE PATENT COOPERATION TREATY-CHAPTER II

PRELIMINARY AMENDMENT

APPLICANTS:	Bernhard Raaf et al.	DOCKET NO: 112740-281
SERIAL NO:	Unknown	GROUP ART UNIT: Unknown
		EXAMINER: Unknown
INTERNATIONAL APPLICATION NO:		PCT/DE00/00309
INTERNATIONAL FILING DATE:		1 February 2000
INVENTION:	METHOD AND DEVICE FOR SYNCHRONIZING A RECEIVER WITH A TRANSMITTER	

Assistant Commissioner for Patents,
Washington, D.C. 20231

Sir:

Please amend the above-identified International Application before entry into the National stage before the U.S. Patent and Trademark Office under 35 U.S.C. §371 as follows:

In the Specification:

Please replace the Specification of the present application, including the Abstract, with the following Substitute Specification:

SPECIFICATION

TITLE

METHOD AND DEVICE FOR SYNCHRONIZING A RECEIVER WITH A TRANSMITTER

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a method for synchronization of a receiver to a transmitter or to a transmission signal in a digital information transmission system, in particular a mobile radio system, with the method having a step of time synchronization,

using at least one filter device which is tuned to a predetermined synchronization code, and also relates to an apparatus for carrying out this method.

Description of the Prior Art

It is known for physical channels to be used for transmitting communication information and synchronization data in information transmission systems. The use of these physical channels results firstly in the transmission of the digitized information and secondly in the transmission of a synchronization signal from a transmitting station to a receiving station, in particular without the use of wires, from a first radio station to a second radio station.

In transmission and communications systems which operate on the basis of the DS-CDMA principle (Direct-Sequence Coding Spread Spectrum Principle), a digital information signal with a narrow bandwidth has a radio-frequency bit stream with a wide bandwidth modulated onto it. The latter is produced by a spread-code generator. In the receiver, a code sequence is produced which is identical to the spread-code sequence as used for modulation in the transmitter. In order to ensure that the receiver operates correctly, this receiver-end code sequence must be synchronized to the transmitter. The "despread" information signal is then obtained by demodulation and integration. The most important task of synchronization during the signal acquisition phase is to detect the timing and phase of a synchronization signal. In addition, there are further important synchronization tasks, depending on the method of operation and protocol of the digital information transmission system, including in particular timeslot (slot) synchronization and frame synchronization for a system which is operated taking account of time-division multiplex or TDMA (Time Division Multiple Access) aspects.

In the futuristic UMTS/WCDMA-FDD (Universal Mobile Telecommunication System/Wideband Code Division Multiple Access-Frequency Division Duplex) system, the present Standardization level proposes a three-stage method for synchronization during the acquisition phase. During the initial cell search, the mobile station searches for that base station to which the transmission loss is the lowest. A primary synchronization channel (PSCH) and a secondary synchronization channel (SSCH) are defined for this purpose. During the first step, PSCH is used to obtain time synchronization with the strongest base station. An individual filter, which is tuned to a primary synchronization code c_p which is common to all the base stations is used to determine peaks for each base station within range

of the mobile station. The detection of the position of the strongest peak provides the timing for the strongest base station modulo the time slot length. In order to improve the reliability, the output from the tuned filter is accumulated incoherently over a number of timeslots.

The second step in the synchronization process is frame synchronization and code group identification for the base station found in the first step, and this is carried out using SSCH. For this purpose, the received signal is correlated with all the secondary synchronization codes (in this case 17) which are possible in accordance with the system protocol at the positions of a secondary synchronization code c_s. The details of this step in the given context are of secondary importance in the same way as those in the third step, which consists of the identification of what is referred to as the scrambling code, which is used by the determined base station. Details of these steps for the system quoted as an example are stated in the system document "ETSI STC SMG2 UMTS-L1 163/98, UTRA/FED Physical Layer Description".

In consequence, a specific physical channel, namely the PSCH, is provided for time synchronization.

An object of the present invention is, therefore, to optimize and improve upon conventional time synchronization process, thus reducing, for example, the measurement time and power consumption associated with the synchronization process.

SUMMARY OF THE INVENTION

Accordingly, the present invention is directed to a method and an apparatus that includes at least one additional physical channel in an information transmission system for time synchronization. This improves the utilization of the received signal energy, reduces the time involved, and reduces the power consumption in the receiver. In this case, the expression physical channel means a channel which is characterized by its frequency, a spread code, the time-window location or a space-division multiplex state.

Time synchronization can include, for example, slot or timeslot synchronization and frame or symbol synchronization.

According to one preferred embodiment of the present invention, a synchronization channel is used which is intended for a purpose other than that of time synchronization in accordance with the transmission protocol for the information transmission system. In the system outlined above, this is the secondary synchronization channel (SSCH). This results in one implementation option, which requires comparatively little computation complexity,

by the code words for the second synchronization channel being obtained by modulation with what are referred to as Hadamard sequences from the code of the primary synchronization channel, or by modulation with some other known code. This is because what is referred to as a "fast Hadamard" transformation can be used for evaluation of the correlation processes in the second synchronization channel for time synchronization purposes.

However, in principle, it is also possible to use at least one monitoring or data channel in the system for time synchronization as well. This requires the definition of particular channel specifications.

The method of the present invention includes separate correlation evaluation in the channels used for time synchronization, with the evaluation results subsequently being linked to form a time synchronization indicator. This linking process is incoherent, provided the system protocol is not based on a fixed phase relationship between the channels used for time synchronization. In this context, it is particularly advantageous to provide a fixed and/or defined phase relationship, in particular of $\pm 90°$ and, wherever possible, also to use the same antenna for transmitting the two channels using the system protocol, which allows linking by coherent accumulation, and hence better detection than incoherent accumulation.

In addition, the method of the present invention offers the capability of storing intermediate results obtained in the time synchronization step, and using them for further steps, for example for identification of the scrambling code.

The method of the present invention is used either permanently or as a function of the satisfaction of a predetermined condition, in particular as a function of the capability to evaluate the signals in the respective channels which can in principle be used for time synchronization, for example, expressed by the signal amplitude overshooting a threshold value, the bit error rate undershooting a threshold value, or the like.

The apparatus for carrying out the method according to the invention is, in particular, suitable for and intended for use in, for example, the mobile station of a mobile radio network. For evaluation purposes, it has a number of correlator stages and a calculation unit for calculating the time synchronization indicator from the outputs from the individual correlator stages using an incoherent or coherent accumulation algorithm chosen depending on the system protocol. The output signals from the correlator stages are linked by linear combination. This results in the following methods for incoherent accumulation in this case:

- combination with equal weights

- square-law combination
- selection method

or coherent accumulation.

Additional features and advantages of the present invention are described in, and will be apparent from, the Detailed Description of the Preferred Embodiment and the Drawings.

DESCRIPTION OF THE DRAWINGS

Figure 1 shows a diagrammatic representation of an embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Figure 1 diagrammatically shows an apparatus 1 for time synchronization, which can be used, for example, as a component of a mobile station (not shown) operating in accordance with the UMTS/WCDM-FDD Standard. A received signal x(k) is subjected to synchronization evaluation in a primary synchronization channel PSCH and in a secondary synchronization channel SSCH. A correlator stage 3 is provided in the primary synchronization channel PSCH.

The correlation stage 3 uses the following relationship for calculation:

$$y_p(\kappa) = \frac{1}{N} \cdot \sum_{k=1..2560} x^*(k+\kappa) \cdot c_p(k) \qquad (1)$$

where:

N is the normalization constant (in this case 2560)

x* *(k)* is the complex-conjugate input signal

c_p is the primary synchronization code in accordance with the UMTS/WCDMA-FDD specification 256 chips (in this case 2560 chips with $c_p = 0$ outside the 256 specified chips)

of the correlation function (correlation) for the primary synchronization channel PSCH.

In the secondary synchronization channel SSCH, the input signal is supplied (in accordance with the protocol definitions worked out at the time of the application) to 17 correlators, which are denoted overall in the figure by the reference number 5. These use the relationship

$$y_s^i(\kappa) = \frac{1}{N} \cdot \sum_{k=1..2560} x^*(k+\kappa) \cdot c_s^i(k) \qquad (2),$$

to define the correlations $y_s^1(\kappa) \ \ldots \ y_s^{17}(\kappa)$,

with the symbols N and x*(k) being explained in the same way as above and in which case, in addition,

c_s^1 is one of 17 secondary synchronization codes in accordance with the UMTS/WCDMA-FDD specification 256 chips (in this case 2560 chips with $c_s^i = 0$ outside the 256 specified chips), i = 1...17 depending on the synchronization code.

The output signals from the correlators 3 and 5 are supplied to an evaluation and calculation unit 7, which calculates the overall correlation z(k) as the time synchronization indicator either coherently using the relationship

$$z(\kappa) = \max_i \left| y_p(\kappa) + k(y_s^i(\kappa)) \right|^2 \qquad (3)$$

or incoherently using the relationship

$$z(\kappa) = \left| y_p(\kappa) \right|^2 + k \left| \max_i (y_s^i(\kappa)) \right|^2 \qquad (4),$$

or

$$z(\kappa) = \left| y_p(\kappa) \right| + k \left| \max_i (y_s^i(\kappa)) \right| \qquad (5),$$

k being a real constant.

In a downstream evaluation stage or unit 9, this is subjected to accumulation modulo the timeslot length, and then to maximum detection in a maximum detector 11, whose output produces the time synchronization to the "best" base station in a mobile radio system.

With regard to the calculation process, the correlation evaluation in the secondary synchronization channel SSCH in the UMTS/WCDMA-FDD system explained by way of example is particularly simple, if the code words for the secondary synchronization channel are formed from the code for the primary synchronization channel PSCH or from some other known code by modulation with what are referred to as Hadamard sequences, as proposed in the Conference Proceedings, from Ericsson, ETSI SMG2 UMTS L1 Export Group, Meeting # 6, Helsinki, FI, September 8-11, 1998. In this case, a fast Hadamard transformation is used, which is likewise described as such in the cited document.

It should be appreciated that the present invention is not limited to the example as previously discussed but can be implemented in a variety of different and suitable ways. For example, the present invention can be utilized in other digital information transmission systems in which time synchronization of a received signal is relevant in a form matched appropriately to the respective system protocol.

It should be understood that various changes and modifications of the presently preferred embodiments described herein will be apparent to those skilled in the art. Such changes and modifications can be made without departing from the spirit and scope of the present invention and without diminishing its attended advantages. It is therefore intended that such changes and modifications be covered by the hereafter appended claims.

ABSTRACT OF THE DISCLOSURE

The present invention relates to a method and an apparatus for time synchronization of a receiver to a transmitter in an information transmission system, such as a mobile radio system. The synchronization can be carried out, at least when a predetermined condition is satisfied, using at least two physical channels in the information transmission system in parallel with one another, by separate correlation evaluation being carried out in the channels.

In the claims:

On page 9, cancel line 1, and substitute the following left-hand justified heading therefor:

We Claim as Our Invention:

Please cancel claims 1-14, without prejudice, and substitute the following claims therefor:

15. A method for synchronization of a receiver with a transmission signal in an information transmission system, the method comprising the steps of:

providing at least two physical channels operable in parallel for receiving and processing the transmission signal;

performing a correlation evaluation of the transmission signal at each physical channel; and

linking the correlation evaluation associated with each of the physical channels for indicating time synchronization of the transmission signal with the receiver.

16. The method as claimed in Claim 15, wherein the information transmission system comprises a mobile radio system.

17. The method as claimed in Claim 15, wherein at least one of the physical channels used for time synchronization is associated with a purpose other than time synchronization in accordance with a transmission protocol in connection with the information transmission system.

18. The method as claimed in Claim 17, wherein the at least one physical channel comprises a transmission signal sequence at least a portion of which is known.

19. The method as claimed in Claim 17, wherein the at least one physical channel comprises a monitoring or data channel in the information transmission system.

20. The method as claimed in Claim 17, wherein the at least one physical channel comprises a synchronization channel for a higher-level frame structure.

21. The method as claimed in Claim 17, wherein the at least one physical channel comprises a secondary synchronization channel that includes known code words formed by modulation with Hadamard sequences such that the correlation evaluation of the secondary synchronization channel is performed via a fast Hadamard transformation.

22. The method as claimed in Claim 15, wherein the information transmission system comprises a transmission protocol that does not include a fixed relationship between the physical channels such that the correlation evaluations associated with each physical channel are linked by incoherent accumulation.

23. The method as claimed in Claim 15, wherein the information transmission system comprises a transmission protocol that includes a fixed or defined phase relationship between the physical channels for transmission via a common antenna such that the correlation evaluations associated with each physical channel are linked by coherent accumulation.

24. The method as claimed in Claim 15, wherein the correlation evaluations associated with each physical channel are stored and subsequently processed via frame synchronization.

25. The method as claimed in Claim 15, wherein time synchronization occurs when a predetermined condition is met that is defined by overshooting or undershooting a threshold value associated with a parameter including a signal amplitude or bit error rate which identifies the capability to evaluate the transmission signal when the correlation evaluation is performed.

26. The method as claimed in Claim 15, wherein the correlation evaluations of the physical channels, prior to linking, are weighted as a function of a parameter including signal amplitude or bit error rate which identifies the capability to evaluate the transmission signal corresponding to each physical channel.

27. An apparatus for synchronization of a receiver with a transmitter in an information transmission system, comprising:

at least two physical channels operable in parallel for receiving and processing a transmission signal from the transmitter;

at least one correlation unit associated with the physical channels for performing a correlation evaluation of the transmission signal on a channel-by-channel basis; and

a calculation unit that links the correlation evaluations derived from the correlation stages for calculating a time synchronization indicator.

28. The apparatus as claimed in Claim 27, wherein the information transmission system comprises a mobile radio system.

29. The apparatus as claimed in Claim 27, wherein the physical channels include a primary synchronization channel for frame or symbol synchronization and a secondary synchronization channel for synchronization to a higher-level frame structure and/or for identification of parameters including a scrambling code group including one or more differently known code words.

30. The apparatus as claimed in Claim 27, wherein the apparatus further comprises an evaluation unit that is connected to the calculation unit for subsequent processing of the transmission signal, and a maximum detector which is connected to the evaluation unit.

31. The apparatus as claimed in Claim 27, wherein the calculation unit performs coherent or incoherent accumulation of output signals derived from the correlation units.

REMARKS

The present amendment makes editorial changes and corrects typographical errors in the specification, which includes the Abstract, in order to conform the specification to the requirements of United States Patent Practice. No new matter is added thereby. Attached hereto is a marked-up version of the changes made to the specification by the present amendment. The attached page is captioned "**Version With Markings To Show Changes Made**".

In addition, the present amendment cancels original claims 1-14 in favor of new claims 15-31. Claims 15-31 have been presented solely because the revisions by red-lining and underlining which would have been necessary in claims 1-14 in order to present those claims in accordance with preferred United States Patent Practice would have been too extensive, and thus would have been too burdensome. The present amendment is intended for clarification purposes only and not for substantial reasons related to patentability pursuant to 35 USC §§103, 102, 103 or 112. Indeed, the cancellation of claims 1-14 does not constitute an intent on the part of the Applicants to surrender any of the subject matter of claims 1-14.

Early consideration on the merits is respectfully requested.

Respectfully submitted,

(Reg. No. 46,541)

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Attorneys for Applicants

VERSIONS WITH MARKINGS TO SHOW CHANGES MADE

In The Specification:

The Specification of the present application, including the Abstract, has been amended as follows:

~~**Description**~~

~~**Method and apparatus for synchronization of a receiver to a transmitter**~~

SPECIFICATION

TITLE

METHOD AND DEVICE FOR SYNCHRONIZING A RECEIVER WITH A TRANSMITTER

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a method for synchronization of a receiver to a transmitter or to a transmission signal in a digital information transmission system, in particular a mobile radio system, with the method having a step of time synchronization, using at least one filter device which is tuned to a predetermined synchronization code, and also relates to an apparatus for carrying out this method.

Description of the Prior Art

It is known for physical channels to be used for transmitting communication information and synchronization data in information transmission systems. The use of these physical channels results firstly in the transmission of the digitized information and secondly in the transmission of a synchronization signal from a transmitting station to a receiving station, in particular without the use of wires, from a first radio station to a second radio station.

In transmission and communications systems which operate on the basis of the DS-CDMA principle (Direct-Sequence Coding Spread Spectrum Principle), a digital information signal with a narrow bandwidth has a radio-frequency bit stream with a wide bandwidth modulated onto it. The latter is produced by a spread-code generator. In the receiver, a code sequence is produced which is identical to the spread-code sequence as used for modulation in the transmitter. In order to ensure that the receiver operates correctly, this receiver-end

code sequence must be synchronized to the transmitter. The "despread" information signal is then obtained by demodulation and integration. The most important task of synchronization during the signal acquisition phase is to detect the timing and phase of a synchronization signal. In addition, there are further important synchronization tasks, depending on the method of operation and protocol of the digital information transmission system, including in particular timeslot (slot) synchronization and frame synchronization for a system which is operated taking account of time-division multiplex or TDMA (Time Division Multiple Access) aspects.

In the futuristic UMTS/WCDMA-FDD (Universal Mobile Telecommunication System/Wideband Code Division Multiple Access-Frequency Division Duplex) system, the present Standardization level proposes a three-stage method for synchronization during the acquisition phase. During the initial cell search, the mobile station searches for that base station to which the transmission loss is the lowest. A primary synchronization channel (PSCH) and a secondary synchronization channel (SSCH) are defined for this purpose. During the first step, PSCH is used to obtain time synchronization with the strongest base station. An individual filter, which is tuned to a primary synchronization code c_p which is common to all the base stations is used to determine peaks for each base station within range of the mobile station. The detection of the position of the strongest peak provides the timing for the strongest base station modulo the time slot length. In order to improve the reliability, the output from the tuned filter is accumulated incoherently over a number of timeslots.

The second step in the synchronization process is frame synchronization and code group identification for the base station found in the first step, and this is carried out using SSCH. For this purpose, the received signal is correlated with all the secondary synchronization codes (in this case 17) which are possible in accordance with the system protocol at the positions of a secondary synchronization code c_s. The details of this step in the given context are of secondary importance in the same way as those in the third step, which consists of the identification of what is referred to as the scrambling code, which is used by the determined base station. Details of these steps for the system quoted as an example are stated in the system document "ETSI STC SMG2 UMTS-L1 163/98, UTRA/FED Physical Layer Description".

In consequence, a specific physical channel, namely the PSCH, is provided for time synchronization.

~~The invention is based on the object of specifying a method of this generic type, in which the received signal energy is made better use of for the~~ An object of the present invention is, therefore, to optimize and improve upon conventional time synchronization process, ~~and~~ thus reducing, for example, the measurement time and power consumption ~~for~~ associated with the synchronization process ~~are thus reduced, and of specifying an apparatus for carrying out this method.~~.

~~With regard to the method aspect, this object is achieved by a method having the features of claim 1, and with regard to its apparatus aspect, the object is achieved by an apparatus having the features of claim 11.~~

SUMMARY OF THE INVENTION

~~The invention includes the fundamental technical teaching of using~~ Accordingly, the present invention is directed to a method and an apparatus that includes at least one additional physical channel in ~~the~~ an information transmission system for time synchronization. This improves the utilization of the received signal energy, reduces the time involved, and reduces the power consumption in the receiver. In this case, the expression physical channel means a channel which is characterized by its frequency, a spread code, the time-window location or a space-division multiplex state.

Time synchronization ~~comprises, in particular~~ can include, for example, slot or timeslot synchronization and frame or symbol synchronization.

According to one preferred embodiment of the present invention, a synchronization channel is used which is intended for a purpose other than that of time synchronization in accordance with the transmission protocol for the information transmission system. In the system outlined above, this is the secondary synchronization channel (SSCH). This results in one implementation option, which requires comparatively little computation complexity, by the code words for the second synchronization channel being obtained by modulation with what are referred to as Hadamard sequences from the code of the primary synchronization channel, or by modulation with some other known code. This is because what is referred to as a "fast Hadamard" transformation can be used for evaluation of the correlation processes in the second synchronization channel for time synchronization purposes.

However, in principle, it is also possible to use at least one monitoring or data channel in the system for time synchronization as well. This requires the definition of particular channel specifications.

The ~~proposed~~ method of the present invention includes separate correlation evaluation in the channels used for time synchronization, with the evaluation results subsequently being linked to form a time synchronization indicator. This linking process is incoherent, provided the system protocol is not based on a fixed phase relationship between the channels used for time synchronization. In this context, it is particularly advantageous to provide a fixed and/or defined phase relationship, in particular of ± 90° and, wherever possible, also to use the same antenna for transmitting the two channels using the system protocol, which allows linking by coherent accumulation, and hence better detection than incoherent accumulation.

In addition, the ~~proposed procedure~~ method of the present invention offers the capability of storing intermediate results obtained in the time synchronization step, and using them for further steps, for example for identification of the scrambling code.

The ~~proposed~~ method of the present invention is used either permanently or as a function of the satisfaction of a predetermined condition, in particular as a function of the capability to evaluate the signals in the respective channels which can in principle be used for time synchronization~~-~~, for example, expressed by the signal amplitude overshooting a threshold value, the bit error rate undershooting a threshold value, or the like.

The apparatus for carrying out the method according to the invention is, in particular, suitable for and intended for use in, for example, the mobile station of a mobile radio network. For evaluation purposes, it has a number of correlator stages and a calculation unit for calculating the time synchronization indicator from the outputs from the individual correlator stages using an incoherent or coherent accumulation algorithm chosen depending on the system protocol. The output signals from the correlator stages are linked by linear combination. This results in the following methods for incoherent accumulation in this case:

- combination with equal weights
- square-law combination
- selection method

or coherent accumulation.

~~Other advantages and useful forms of the solution according to the invention can be found in the dependent claims and in the following description of one preferred embodiment, with reference to the figure.~~ Additional features and advantages of the present invention are

described in, and will be apparent from, the Detailed Description of the Preferred Embodiment and the Drawings.

~~The figure shows an outline illustration, which is used in the following text both to explain one embodiment of~~

DESCRIPTION OF THE DRAWINGS

~~the method and to explain a preferred apparatus for carrying out the method.~~ Figure 1 shows a diagrammatic representation of an embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

~~The figure~~ Figure 1 diagrammatically shows an apparatus 1 for time synchronization, which can be used, for example, as a component of a mobile station (not ~~illustrated overall~~) shown) operating in accordance with the UMTS/WCDM-FDD Standard. A received signal x(k) is subjected to synchronization evaluation in a primary synchronization channel PSCH and in a secondary synchronization channel SSCH. A correlator stage 3 is provided in the primary synchronization channel PSCH.

The correlation stage 3 uses the following relationship for calculation:

$$y_p(\kappa) = \frac{1}{N} \cdot \sum_{k=1..2560} x^*(k+\kappa) \cdot c_p(k) \qquad (1)$$

where:

N is the normalization constant (in this case 2560)

x* *(k)* is the complex-conjugate input signal

c_p is the primary synchronization code in accordance with the UMTS/WCDMA-FDD specification 256 chips (in this case 2560 chips with $c_p = 0$ outside the 256 specified chips)

of the correlation function (correlation) for the primary synchronization channel PSCH.

In the secondary synchronization channel SSCH, the input signal is supplied (in accordance with the protocol definitions worked out at the time of the application) to 17 correlators, which are denoted overall in the figure by the reference number 5. These use the relationship

$$y_s^i(\kappa) = \frac{1}{N} \cdot \sum_{k=1..2560} x^*(k+\kappa) \cdot c_s^i(k) \qquad (2),$$

to define the correlations $y_s^1(\kappa)$ ... $y_s^{17}(\kappa)$,

with the symbols N and x*(k) being explained in the same way as above and in which case, in addition,

c_s^i [redacted] is one of 17 secondary synchronization codes in accordance with the UMTS/WCDMA-FDD specification 256 chips (in this case 2560 chips with c_s^i [redacted] = 0 outside the 256 specified chips), i = 1...17 depending on the synchronization code.

The output signals from the correlators 3 and 5 are supplied to an evaluation and calculation unit ~~9~~ 7, which calculates the overall correlation z(k) as the time synchronization indicator either coherently using the relationship

$$z(\kappa) = \max_i \left| y_p(\kappa) + k(y_s^i(\kappa)) \right|^2 \qquad (3)$$

or incoherently using the relationship

$$z(\kappa) = \left| y_p(\kappa) \right|^2 + k \left| \max_i (y_s^i(\kappa)) \right|^2 \qquad (4),$$

or

$$z(\kappa) = \left| y_p(\kappa) \right| + k \left| \max_i (y_s^i(\kappa)) \right| \qquad (5),$$

k being a real constant.

In a downstream evaluation stage or unit 9, this is subjected to accumulation modulo the timeslot length, and then to maximum detection in a maximum detector 11, whose output produces the time synchronization to the "best" base station in a mobile radio system.

With regard to the calculation process, the correlation evaluation in the secondary synchronization channel SSCH in the UMTS/WCDMA-FDD system explained by way of example is particularly simple, if the code words for the secondary synchronization channel are formed from the code for the primary synchronization channel PSCH or from some other known code by modulation with what are referred to as Hadamard sequences, as proposed in the Conference Proceedings, from Ericsson, ETSI SMG2 UMTS L1 Export Group,

Meeting # 6, Helsinki, FI, September 8-11, 1998. In this case, a fast Hadamard transformation is used, which is likewise described as such in the cited document.

~~The implementation of the invention is not restricted to this example but - in a form matched appropriately to the respective system protocol - is also feasible~~ It should be appreciated that the present invention is not limited to the example as previously discussed but can be implemented in a variety of different and suitable ways. For example, the present invention can be utilized in other digital information transmission systems in which time synchronization of a received signal is relevant in a form matched appropriately to the respective system protocol.

It should be understood that various changes and modifications of the presently preferred embodiments described herein will be apparent to those skilled in the art. Such changes and modifications can be made without departing from the spirit and scope of the present invention and without diminishing its attended advantages. It is therefore intended that such changes and modifications be covered by the hereafter appended claims.

ABSTRACT OF THE DISCLOSURE

~~**Abstract**~~

~~Method and apparatus for time synchronization of a receiver to a transmitter~~

The present invention relates to a.~~A~~ method and an apparatus ~~are described~~ for time synchronization of a receiver to a transmitter in an information transmission system, ~~in particular~~ such as a mobile radio system~~, with the~~. The synchronization ~~being~~ can be carried out, at least when a predetermined condition is satisfied, using at least two physical channels in the information transmission system in parallel with one another, by separate correlation evaluation being carried out in the channels.

Description

Method and apparatus for synchronization of a receiver to a transmitter

The invention relates to a method for synchronization of a receiver to a transmitter or to a transmission signal in a digital information transmission system, in particular a mobile radio system, with the method having a step of time synchronization, using at least one filter device which is tuned to a predetermined synchronization code, and also relates to an apparatus for carrying out this method.

It is known for physical channels to be used for transmitting communication information and synchronization data in information transmission systems. The use of these physical channels results firstly in the transmission of the digitized information and secondly in the transmission of a synchronization signal from a transmitting station to a receiving station, in particular without the use of wires, from a first radio station to a second radio station.

In transmission and communications systems which operate on the basis of the DS-CDMA principle (Direct-Sequence Coding Spread Spectrum Principle), a digital information signal with a narrow bandwidth has a radio-frequency bit stream with a wide bandwidth modulated onto it. The latter is produced by a spread-code generator. In the receiver, a code sequence is produced which is identical to the spread-code sequence as used for modulation in the transmitter. In order to ensure that the receiver operates correctly, this receiver-end code sequence must be synchronized to the transmitter. The "despread" information signal is then obtained by demodulation and integration. The most important task

of synchronization during the signal acquisition phase is to detect the timing and phase of a synchronization signal. In addition,

there are further important synchronization tasks, depending on the method of operation and protocol of the digital information transmission system, including in particular timeslot (slot) synchronization and frame synchronization for a system which is operated taking account of time-division multiplex or TDMA (Time Division Multiple Access) aspects.

In the futuristic UMTS/WCDMA-FDD (Universal Mobile Telecommunication System/Wideband Code Division Multiple Access-Frequency Division Duplex) system, the present Standardization level proposes a three-stage method for synchronization during the acquisition phase. During the initial cell search, the mobile station searches for that base station to which the transmission loss is the lowest. A primary synchronization channel (PSCH) and a secondary synchronization channel (SSCH) are defined for this purpose. During the first step, PSCH is used to obtain time synchronization with the strongest base station. An individual filter, which is tuned to a primary synchronization code c_p which is common to all the base stations is used to determine peaks for each base station within range of the mobile station. The detection of the position of the strongest peak provides the timing for the strongest base station modulo the time slot length. In order to improve the reliability, the output from the tuned filter is accumulated incoherently over a number of timeslots.

The second step in the synchronization process is frame synchronization and code group identification for the base station found in the first step, and this is carried out using SSCH. For this purpose, the received signal is correlated with all the secondary synchronization codes (in this case 17) which are possible in accordance with the system protocol at the positions of a secondary synchronization code c_s. The

details of this step in the given context are of secondary importance in the same way as those in the third step, which consists of the identification of what is referred to as the scrambling code, which is used by the determined base station. Details of these steps for the system quoted as an example are stated in the system document "ETSI STC SMG2 UMTS-L1 163/98, UTRA/FED Physical Layer Description".

In consequence, a specific physical channel, namely the PSCH, is provided for time synchronization.

The invention is based on the object of specifying a method of this generic type, in which the received signal energy is made better use of for the time synchronization process, and the measurement time and power consumption for the synchronization process are thus reduced, and of specifying an apparatus for carrying out this method.

With regard to the method aspect, this object is achieved by a method having the features of claim 1, and with regard to its apparatus aspect, the object is achieved by an apparatus having the features of claim 11.

The invention includes the fundamental technical teaching of using at least one additional physical channel in the information transmission system for time synchronization. This improves the utilization of the received signal energy, reduces the time involved, and reduces the power consumption in the receiver. In this case, the expression physical channel means a channel which is characterized by its frequency, a spread code, the time-window location or a space-division multiplex state.

Time synchronization comprises, in particular, slot or timeslot synchronization and frame or symbol synchronization.

According to one preferred embodiment of the invention, a synchronization channel is used which is intended for a purpose other than that of time synchronization in accordance with the transmission protocol for the information transmission system. In the system outlined above, this is the secondary synchronization channel (SSCH). This results in one implementation option, which requires comparatively little computation complexity, by the code words for the second synchronization channel being obtained by modulation with what are referred to as Hadamard sequences from the code of the primary synchronization channel, or by modulation with some other known code. This is because what is referred to as a "fast Hadamard" transformation can be used for evaluation of the correlation processes in the second synchronization channel for time synchronization purposes.

However, in principle, it is also possible to use at least one monitoring or data channel in the system for time synchronization as well. This requires the definition of particular channel specifications.

The proposed method includes separate correlation evaluation in the channels used for time synchronization, with the evaluation results subsequently being linked to form a time synchronization indicator. This linking process is incoherent, provided the system protocol is not based on a fixed phase relationship between the channels used for time synchronization. In this context, it is particularly advantageous to provide a fixed and/or defined phase relationship, in particular of ± 90° and, wherever possible, also to use the same antenna for transmitting the two channels using the system protocol, which allows linking by coherent accumulation, and hence better detection than incoherent accumulation.

In addition, the proposed procedure offers the capability of storing intermediate results obtained in the time

synchronization step, and using them for further steps, for example for identification of the scrambling code.

The proposed method is used either permanently or as a function of the satisfaction of a predetermined condition, in particular as a function of the capability to evaluate the signals in the respective channels which can in principle be used for time synchronization - for example expressed by the signal amplitude overshooting a threshold value, the bit error rate undershooting a threshold value, or the like.

The apparatus for carrying out the method according to the invention is, in particular, suitable for and intended for use in the mobile station of a mobile radio network. For evaluation purposes, it has a number of correlator stages and a calculation unit for calculating the time synchronization indicator from the outputs from the individual correlator stages using an incoherent or coherent accumulation algorithm chosen depending on the system protocol. The output signals from the correlator stages are linked by linear combination. This results in the following methods for incoherent accumulation in this case:

- combination with equal weights
- square-law combination
- selection method

or coherent accumulation.

Other advantages and useful forms of the solution according to the invention can be found in the dependent claims and in the following description of one preferred embodiment, with reference to the figure.

The figure shows an outline illustration, which is used in the following text both to explain one embodiment of the method and to explain a preferred apparatus for carrying out the method.

The figure shows an apparatus 1 for time synchronization, which can be used as a component of a mobile station (not illustrated overall) operating in accordance with the UMTS/WCDM-FDD Standard. A received signal x(k) is subjected to synchronization evaluation in a primary synchronization channel PSCH and in a secondary synchronization channel SSCH. A correlator stage 3 is provided in the primary synchronization channel PSCH.

The correlation stage 3 uses the following relationship for calculation:

$$y_p(\kappa) = \frac{1}{N} \cdot \sum_{k=1..2560} x^*(k+\kappa) \cdot c_p(k) \qquad (1)$$

where:

N is the normalization constant (in this case 2560)

$x^*(k)$ is the complex-conjugate input signal

c_p is the primary synchronization code in accordance with the UMTS/WCDMA-FDD specification 256 chips (in this case 2560 chips with $c_p = 0$ outside the 256 specified chips)

of the correlation function (correlation) for the primary synchronization channel PSCH.

In the secondary synchronization channel SSCH, the input signal is supplied (in accordance with the protocol definitions worked out at the time of the application) to 17 correlators, which are denoted overall in the figure by the reference number 5. These use the relationship

$$y_s^j(\kappa) = \frac{1}{N} \cdot \sum_{k=1..2560} x^*(k+\kappa) \cdot c_s^j(k) \qquad (2),$$

to define the correlations $y_s^1(\kappa)$ ... $y_s^{17}(\kappa)$,

with the symbols N and $x^*(k)$ being explained in the same way as above and in which case, in addition,

c_s^i is one of 17 secondary synchronization codes in accordance with the UMTS/WCDMA-FDD specification 256 chips (in this case 2560 chips with $c_s^i = 0$ outside the 256 specified chips), i = 1...17 depending on the synchronization code.

The output signals from the correlators 3 and 5 are supplied to an evaluation and calculation unit 9, which calculates the overall correlation z(k) as the time synchronization indicator either coherently using the relationship

$$z(\kappa) = \max_i \left| y_p(\kappa) + k(y_s^j(\kappa)) \right|^2 \qquad (3)$$

or incoherently using the relationship

$$z(\kappa) = \left| y_p(\kappa) \right|^2 + k \left| \max_i (y_s^i(\kappa)) \right|^2 \qquad (4),$$

or

$$z(\kappa) = \left| y_p(\kappa) \right| + k \left| \max_i (y_s^i(\kappa)) \right| \qquad (5),$$

k being a real constant.

In a downstream evaluation stage 9, this is subjected to accumulation modulo the timeslot length, and then to

maximum detection in a maximum detector 11, whose output produces the time synchronization to the "best" base station in a mobile radio system.

With regard to the calculation process, the correlation evaluation in the secondary synchronization channel SSCH in the UMTS/WCDMA-FDD system explained by way of example is particularly simple, if the code words for the secondary synchronization channel are formed from the code for the primary synchronization channel PSCH or from some other known code by modulation with what are referred to as Hadamard sequences, as proposed in the Conference Proceedings, from Ericsson, ETSI SMG2 UMTS L1 Export Group, Meeting # 6, Helsinki, FI, September 8-11, 1998. In this case, a fast Hadamard transformation is used, which is likewise described as such in the cited document.

The implementation of the invention is not restricted to this example but - in a form matched appropriately to the respective system protocol - is also feasible in other digital information transmission systems in which time synchronization of a received signal is relevant.

Patent Claims

1. A method for synchronization of a receiver to a transmitter or to a transmission signal in an information transmission system, in particular a mobile radio system, with the method having a step of time synchronization,
characterized
in that at least two physical channels in the information transmission system are used in parallel with one another for synchronization, a separate correlation evaluation is carried out, and the evaluation results for the channels (Y_p (k), y_s^1 (k)...y_s^{17} (k)) are then linked to form a time synchronization indicator.

2. The method as claimed in claim 1,
characterized
in that at least one channel, which is intended for some other purpose and has a transmission signal sequence which is at least partially known, is used for time synchronization.

3. The method as claimed in claim 1 or 2,
characterized
in that the channel whose transmission signal sequence is at least partially known is a monitoring or data channel in the information transmission system.

4. The method as claimed in claim 2,
characterized
in that the channel whose transmission signal sequence is at least partially known is a synchronization channel, in particular for a higher-level frame structure.

5. The method as claimed in one of the preceding claims,
characterized in that the known code words in a second channel are formed by modulation with Hadamard sequences, and the correlation

evaluation in the second channel is carried out using a fast Hadamard transformation.

6. The method as claimed in one of the preceding claims,
characterized
in that the protocol for the information transmission system does not provide any fixed phase relationship between the channels used for time synchronization, and the evaluation results for the channels are linked by incoherent accumulation.

7. The method as claimed in one of the preceding claims,
characterized
in that the protocol for the information transmission system provides a fixed or defined phase relationship between the channels used for time synchronization and, in particular, also provides for these channels to be transmitted via the same antenna, and the evaluation results for the channels are linked by coherent accumulation.

8. The method as claimed in one of the preceding claims,
characterized
in that the results obtained in the time synchronization step are stored and are used for a further synchronization step, in particular for frame synchronization.

9. The method as claimed in one of the preceding claims,
characterized
in that the overshooting or undershooting of a threshold value for a parameter which identifies the capability to evaluate the signals in the

corresponding channel, in particular the signal amplitude or the bit error rate, is defined as a predetermined condition.

10. The method as claimed in one of the preceding claims,
characterized
in that the evaluation results for the channels are weighted before the linking process, as a function of a parameter which identifies the capability to evaluate the signals in the corresponding channel, in particular the signal amplitude or the bit error rate.

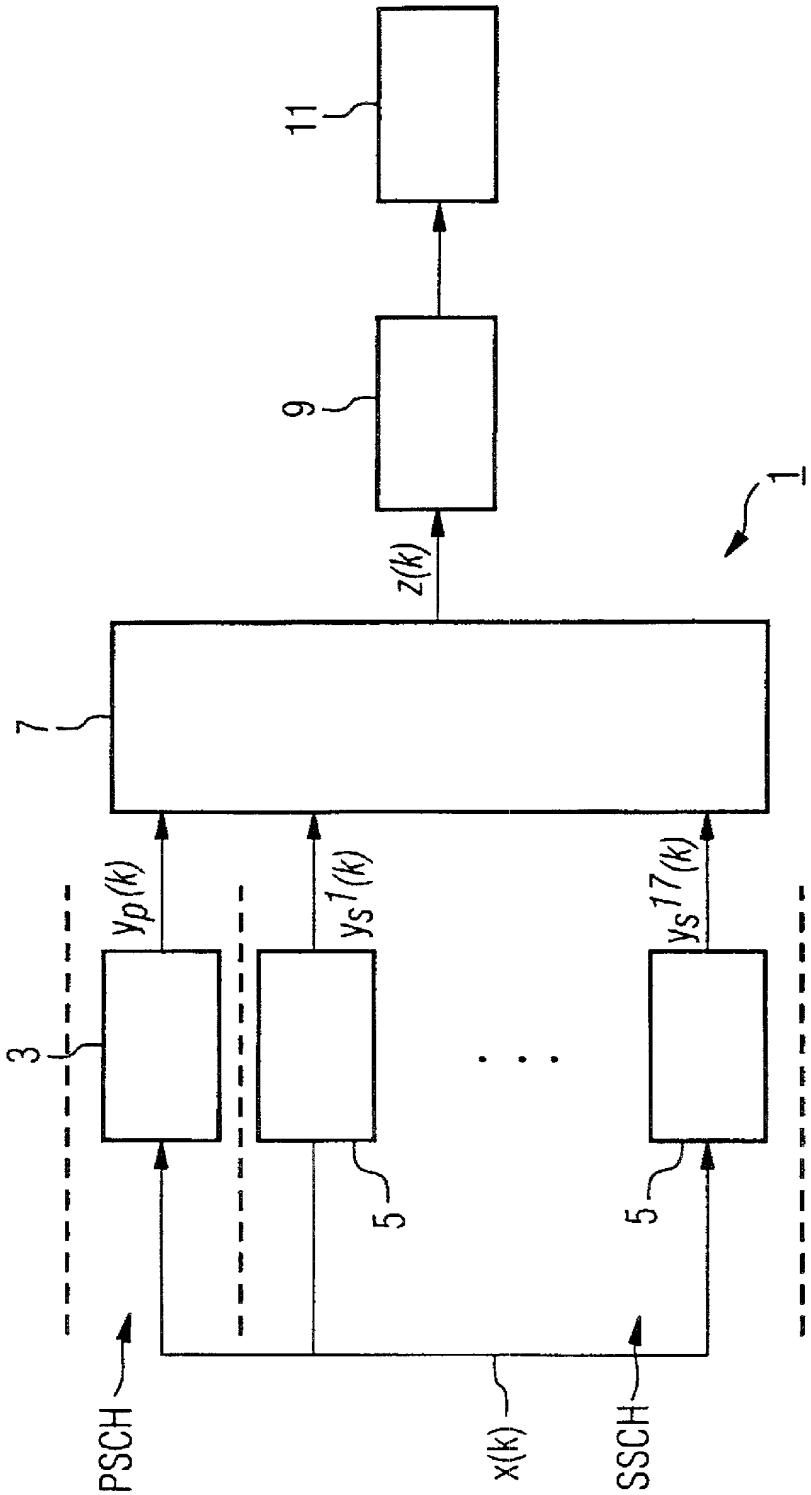
11. An apparatus for carrying out the method as claimed in one of the preceding claims, in particular for use in the mobile station of a mobile radio network, having a receiving section for the channels used for time synchronization,
characterized by
in each case at least one correlator stage (3, 5), which is associated with the channels (PSCH, SSCH) that are used, for determining the received signal correlation (Y_p (k), y_s^1 (k)...y_s^{17} (k)) on a channel-by-channel basis, and a calculation unit (7), which is downstream from the correlator stages, for calculating the time synchronization indicator (z(k)).

12. The apparatus as claimed in claim 11,
characterized by
configuration for determining and evaluating the correlation in a primary synchronization channel for frame or symbol synchronization, and in a secondary synchronization channel for synchronization to a higher-level frame structure and/or for identification of further parameters, such as a scrambling code group, which comprises one or more different but known code words.

13. The apparatus as claimed in claim 12,
characterized by

an evaluation stage (9), which is downstream from the calculation unit (7), for accumulation, and a maximum detector (11) which is connected to the output of said evaluation stage (9).

14. The apparatus as claimed in one of claims 11 to 13,
characterized by
configuration of the calculation unit (7) for coherent or incoherent accumulation of the output signals (y_p (k), y_s^1 (k)...y_s^{17} (k)) from the correlator stages (3, 5).



Declaration and Power of Attorney For Patent Application
Erklärung Für Patentanmeldungen Mit Vollmacht
German Language Declaration

Als nachstehend benannter Erfinder erkläre ich hiermit an Eides Statt:

As a below named inventor, I hereby declare that:

dass mein Wohnsitz, meine Postanschrift, und meine Staatsangehörigkeit den im Nachstehenden nach meinem Namen aufgeführten Angaben entsprechen,

My residence, post office address and citizenship are as stated below next to my name,

dass ich, nach bestem Wissen der ursprüngliche, erste und alleinige Erfinder (falls nachstehend nur ein Name angegeben ist) oder ein ursprünglicher, erster und Miterfinder (falls nachstehend mehrere Namen aufgeführt sind) des Gegenstandes bin, für den dieser Antrag gestellt wird und für den ein Patent beantragt wird für die Erfindung mit dem Titel:

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Verfahren und Vorrichtung zur Synchronisation eines Empfaengers mit einem Sender

Method and device for synchronizing a receiver with a transmitter

deren Beschreibung

(zutreffendes ankreuzen)
☐ hier beigefügt ist.
☒ am 01.02.2000 als
PCT internationale Anmeldung
PCT Anmeldungsnummer PCT/DE00/00309
eingereicht wurde und am ______
abgeändert wurde (falls tatsächlich abgeändert).

the specification of which

(check one)
☐ is attached hereto.
☒ was filed on 01.02.2000 as
PCT international application
PCT Application No. PCT/DE00/00309
and was amended on ______
(if applicable)

Ich bestätige hiermit, dass ich den Inhalt der obigen Patentanmeldung einschliesslich der Ansprüche durchgesehen und verstanden habe, die eventuell durch einen Zusatzantrag wie oben erwähnt abgeändert wurde.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims as amended by any amendment referred to above.

Ich erkenne meine Pflicht zur Offenbarung irgendwelcher Informationen, die für die Prüfung der vorliegenden Anmeldung in Einklang mit Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) von Wichtigkeit sind, an.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

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I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

IDNR: 2590 / V: 99-1.00 / B:Val

German Language Declaration

Prior foreign appplications
Priorität beansprucht

Priority Claimed

19907130.6	DE	19.02.1999	☒	☐
(Number) (Nummer)	(Country) (Land)	(Day Month Year Filed) (Tag Monat Jahr eingereicht)	Yes Ja	No Nein
			☐	☐
(Number) (Nummer)	(Country) (Land)	(Day Month Year Filed) (Tag Monat Jahr eingereicht)	Yes Ja	No Nein
			☐	☐
(Number) (Nummer)	(Country) (Land)	(Day Month Year Filed) (Tag Monat Jahr eingereicht)	Yes Ja	No Nein

Ich beanspruche hiermit gemäss Absatz 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 120, den Vorzug aller unten aufgeführten Anmeldungen und falls der Gegenstand aus jedem Anspruch dieser Anmeldung nicht in einer früheren amerikanischen Patentanmeldung laut dem ersten Paragraphen des Absatzes 35 der Zivilprozeßordnung der Vereinigten Staaten, Paragraph 122 offenbart ist, erkenne ich gemäss Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) meine Pflicht zur Offenbarung von Informationen an, die zwischen dem Anmeldedatum der früheren Anmeldung und dem nationalen oder PCT internationalen Anmeldedatum dieser Anmeldung bekannt geworden sind.

I hereby claim the benefit under Title 35. United States Code. §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §122, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occured between the filing date of the prior application and the national or PCT international filing date of this application.

PCT/DE00/00309	01.02.2000	anhängig	pending
(Application Serial No.) (Anmeldeseriennummer)	(Filing Date D, M, Y) (Anmeldedatum T, M, J)	(Status) (patentiert, anhängig, aufgegeben)	(Status) (patented, pending, abandoned)
(Application Serial No.) (Anmeldeseriennummer)	(Filing Date D,M,Y) (Anmeldedatum T, M; J)	(Status) (patentiert, anhängig, aufgeben)	(Status) (patented, pending, abandoned)

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

German Language Declaration

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Telephone: (001) 312 372 11 21 and Facsimile (001) 312 372 20 98
or
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Unterschrift des Erfinders — Datum 13.8.01	Inventor's signature — Date
Wohnsitz: MUENCHEN, DEUTSCHLAND	Residence: MUENCHEN, GERMANY DEX
Staatsangehörigkeit: DE	Citizenship: DE
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81737 MUENCHEN	81737 MUENCHEN
Voller Name des zweiten Miterfinders (falls zutreffend):	Full name of second joint inventor, if any:
BERNHARD RAAF	BERNHARD RAAF
Unterschrift des Erfinders — Datum 26.09.01	Second Inventor's signature — Date
Wohnsitz: MUENCHEN, DEUTSCHLANDG	Residence: MUENCHEN, GERMANY DEX
Staatsangehörigkeit: DE	Citizenship: DE
Postanschrift: MAXHOFSTR. 62	Post Office Address: MAXHOFSTR. 62
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(Bitte entsprechende Informationen und Unterschriften im Falle von dritten und weiteren Miterfindern angeben).

(Supply similar information and signature for third and subsequent joint inventors).